21st Century Laboratory at Sandia National Laboratories

Energy 2001, Kansas City
June 6, 2001

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Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the U.S.Department of Energy under Contract DE-ACD4-94A185000

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- NM & CA Sites, about 6M GSF
- Multiprogram - primarily national defense and energy systems
- Energy Use index at end of FY00
  - 586,500 BTU/SF/yr for “process” category
  - 193,700 BTU/SF/yr for all others
- Electric use intensity - NM site
  - 116 kWh/SF/yr; 29 kWh/SF/yr

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Process and Environmental Technology Laboratory (PETL)

- Analytical materials science lab in NM
  - Primary – aging and reliability of nuclear weapons components
- Two-year Construction complete June 2000, occupancy began immediately
- 151,055 gross ft^2; 60,000 ft^2 in lab space
- Entire lab designed to meet H-6 requirements
  - H-6 is UBC hazardous occupancy rating

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Process and Environmental Technology Laboratory (PETL)

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Process and Environmental Technology Laboratory (PETL)

- Central core of laboratories, offices on perimeter
- Layout separates workers from chemicals, called chemical free zones (CFZ)
- Service corridors between the labs
- Waffle slab construction to reduce vibration
- Basement and penthouse equipment rooms

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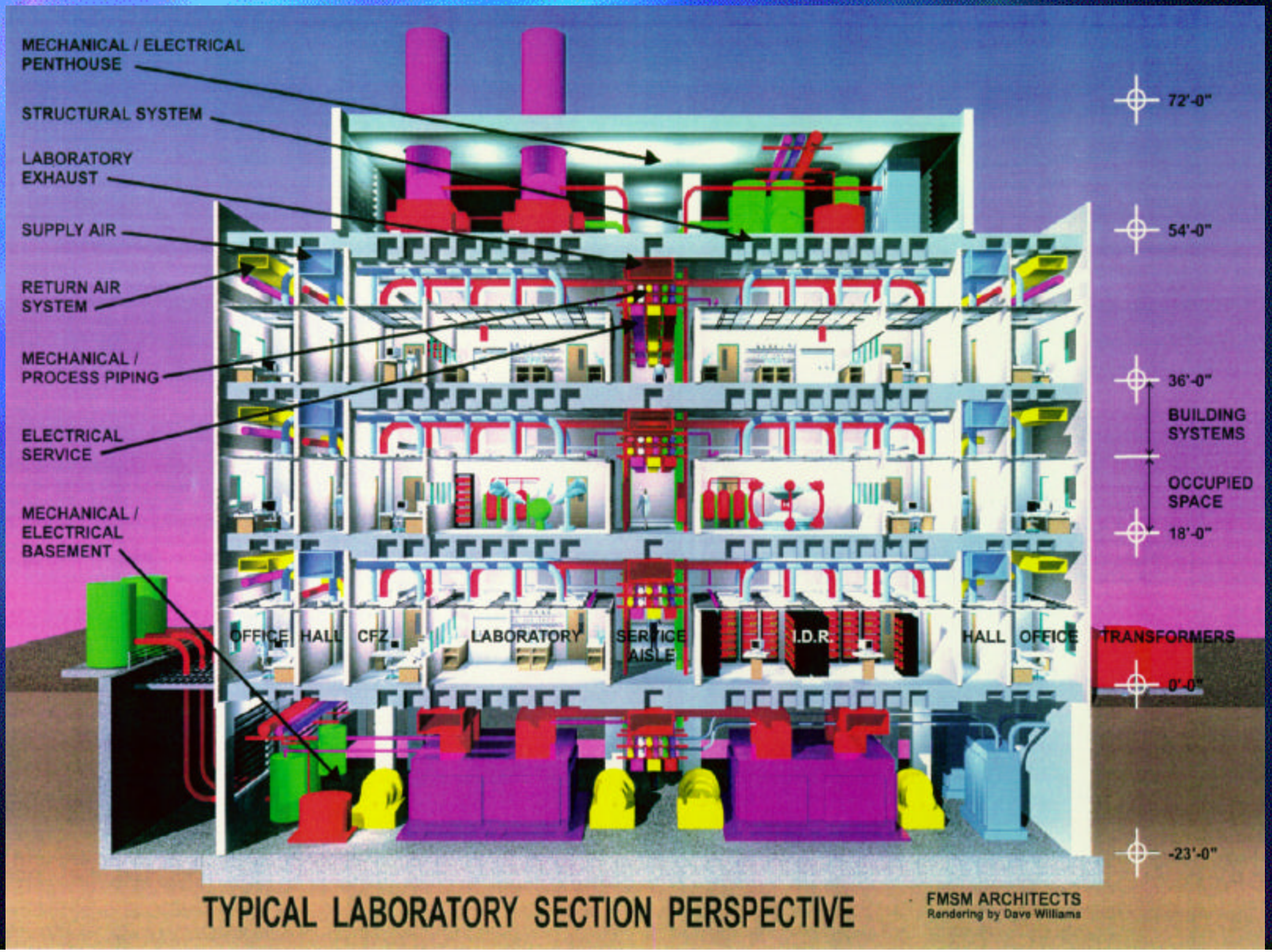
Laboratory Section Perspective



PETL, Energy Intensive

- Energy intensive due to lab equipment and lab exhaust requirements
- Categorized as a “Process” Lab, for DOE Energy Reporting requirements
- Metered electricity consumption during the last 7 months of construction - > 1 million kWh

Requirements (DOE Order)

- DOE Order 430.2 (section 4.e) on new facilities > 10,000 ft^2
- Design must comply with 10 CFR 435 - Energy Conservation Performance Standards
  - purpose of Energy Conservation Report
  - most cost-effective alternative
- Commissioning, to achieve design performance

Energy-Efficient Design for PETL, Background

- Title I ECR submitted by Design Team
- Energy baseline = 595,000 BTU/ft^2/yr
- Baseline 20%> than average annual energy use for SNL “process” facilities
- Design apparently following “rule of thumb” approach
- Energy Manager became more involved

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Energy-Efficient Design for PETL, Role of Energy Manager

- Guidance on ECR and alternatives
- Dispel “rule of thumb” engineering
- Provide benchmarks, help set targets
- Ensure energy systems analysis (DOE 2.1E) and Life Cycle Cost analysis are completed for base case and each alternative

Energy-Efficient Design for PETL, improvements selected

- Variable frequency drives applied to fans and pumps
  - Premium Efficiency Motors
- Year-round Energy Recovery System, with Evaporative Cooling assist in summer
- Chilled Water Thermal Energy Storage
  - Million gallons; 10,000 ton-hours
- Premium Efficiency, multiple Boiler System

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PETL - Chilled Water TES impact

Chilled Water TES system meets all PETL Cooling needs, saving about 1.2 MW peak demand; Also a major impetus for dramatic improvements in existing operation.

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Energy-Efficient Design for PETL, Improvements, continued

- Lighting System
  - T-8's & electronic ballasts
  - microprocessor-based timer control in labs
  - occupancy sensors in common areas
- Validating Lab Equipment Diversity
- Improvement in Duct Design
  - 1/3 reduction in duct pressure drop; reduction in motor size
- Commissioning Specification – first time

Energy Recovery System, Design Performance

Season	Supply			Exhaust			SENSIBLE ENERGY RECOVERY BTU/HR
	SCFM	TEMP. F DB/WB		SCFM	TEMP. F DB/WB		
		IN	OUT		IN	OUT	
Winter Weather	151,300	12/10	45/31	151,300	72/60	46/46	4,443,681
Summer Weather	151,300	97/61	77/53	151,300	58/56	78/63	2,693,140
Moderate Weather	152,200	84/59	75/57	151,800	58/56	59/69	1,219,122

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Energy and Cost Savings

Energy Improvement	Added Cost	Energy Saved/yr		$/yr Saved	PB (YR)	ROI (%)
		KWhr	Therm			
VFD	$109K	1082	0	62K	1.8	46
Energy Recovery	$330K	249K	90K	32K	10.4	8
Thermal Storage	$240K	56K	0	104K	2.3	39
Motors	$7K	55K	0	8K	2.2	36
Boilers	$9K		30	7K	1.1	90

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Energy and Emissions - Savings Summary

	Title I	Title II Complete
Energy Intensity (BTU/ft^2/yr)	594,700	340,200
First Costs	$666,000	$1,360,000
Annual Savings	$235,000	
in kWh	2 million	
in Therms	190,000	
Reduced Emissions	2900 tons	

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Pollution Prevention, Resource Conservation

- Pollution reduced, source and site
  - 57% of SNL electric is coal-fired (utility mix)
  - CO_2, SO_2, NO_X, CO, PM-10
- Resources saved, source and site
  - Coal, water, natural gas, chemicals
- Societal benefits
  - \$8.40/ton CO_2, \$0.75/pound SO_2

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PETL Energy use, design vs. actual

	GSF	Electric, kWh	Gas, therms	BTU/SF/yr
Title I, 1996	128,400	10,172,850	416,460	594,700
Title II, 1997	150,640	8,464,000	223,700	340,200
Actual, 2000-1	151,055	5,879,470	182,680	254,000

Energy-Efficient Design for PETL, Summary

- Complete energy analysis for building and laboratory space
  - 30% < average use of Process category of buildings
  - ~ 80% attributable to laboratory operations
- Design took longer, ~4% added to capital cost, but life cycle costs are less
- ECR is a tool to account for total savings

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Process and Environmental Technology Laboratory (PETL)

- Lessons Learned
  - Essentially, follow the Labs21 Checklist
    - Engage qualified commissioning authority in design phase
    - Understand applicable codes and standards
    - Right-size the equipment
  - Sets good example for future designs
    - Need to capture and publicize performance & resultant savings

Laboratories for the 21st Century

- PETL building in process of being written up as Case Study for Labs 21
- SNL is a Pilot Partner for a new 377,000 GSF multi-building project
  - Following the Labs 21 approach, as best as possible

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